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PUBLIC HEALTH REPORTS

VOL. 33 AUGUST 16, 1918 No. 33

HOW INDUSTRIAL FATIGUE MAY BE REDUCED.

The following is a preliminary report of the Divisional Committee on Industrial Fatigue of the Section on Sanitation of the Welfare Committee of the Committee on Labor of the Advisory Commission, Council of National Defense.

This report is published by permission of Mr. Samuel Gompers, chairman of the Committee on Labor.

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INTRODUCTION.

The Divisional Committee on Industrial Fatigue has been active in planning and conducting investigations in factories that are manufacturing war supplies, for the purpose of determining whether unnecessary fatigue is present and discovering the conditions under which a maximum continuous output may be obtained. The work of investigation has been carried on under the auspices of the Division of Scientific Research of the United States Public Health Service, which appointed to its staff several members of the committee and paid the entire expenses of the investigations. In addition to the work of investigation, the divisional committee has prepared the accompanying paper on "How Industrial Fatigue May Be Reduced." This paper is intended chiefly for manufacturers, and presents in direct form some of the principal phases of the subject as it is now known.

FREDERIC S. LEE,
Executive Secretary.

JANUARY, 1918.

HOW INDUSTRIAL FATIGUE MAY BE REDUCED.

In the present emergency caused by the war it is desirable to understand all practicable ways by which industrial work may be made more efficient and output may be increased to a maximum without resorting to unwise or burdensome demands on labor. It is often possible to increase output temporarily by increasing the work of the employee but, if he is overworked, his output soon falls off; hence such a method, if carried far, quickly defeats itself and in the long run is not profitable. Given adequate equipment, adequate administration of the plant, and a proper spirit among the employees, fatigue is the greatest single obstacle to a maximum output. Fatigue diminishes output not only directly, but indirectly, by increasing accidents and the proportion of spoiled work and by causing sickness and absences of employees. It will, therefore, be profitable to employers, to employees and to the Nation itself, to inquire into the ways by which fatigue may be reduced.

Ways of Detecting Fatigue.

Everyone knows that a certain degree of fatigue is the normal result of bodily activity and is harmless. But it is not so generally recognized that the onset of over-fatigue may be greatly hastened, and that through it deleterious effects on both the worker and the plant may be caused by the conditions of work inside the factories, or by the occupation, habits and conditions of living of the workers outside the factories, or by both.

In order to be sure that an individual is really fatigued, objective methods of measurement must be used—one often feels tired without actually being so, and likewise fatigue is often present before it is recognized by the individual. Fatigue may be detected by various tests, some of which have been studied so carefully and so improved that they can now be considered as fairly accurate and useful for practical purposes. Different methods are applicable to different cases.

Amount of output.—One of the readiest means of detecting fatigue is by keeping a record of the output of the individual employee by the hour, the day, or the week and observing its course. A falling off in the output, when not explicable by other changes in the conditions of the work, indicates fatigue. Where the duration of the working period has been changed, fatigue can also be tested by comparing the average output per hour under the earlier and the later schedules.

Amount of power used.—A fall in the amount of electrical or other power consumed in a factory, or one of its departments, is often an excellent index of decreased output and thus of the fatigue of the workers. Lessened consumption of power must of course be discounted where it results from temporary shut-downs or other obvious causes.

Other indicators of fatigue.—Fatigue is also often indicated by the amount of spoiled work turned out by the workers, by the number of accidents to the workers occurring during a working period, by the number of absences from work, and in extreme cases by records of sickness.

Laboratory tests of fatigue.—There are various tests of the presence of fatigue that have been supplied by the laboratories, some of which are applicable to industrial workers. These concern the muscles, the nervous system, sight, and hearing, and certain chemical changes within the body.

Ways of Reducing Fatigue.

Various ways are now known by which fatigue can be reduced without decreasing the output and even in some cases with an increase of it. When fatigue is caused by work inside factories it is obviously controlled more easily than when caused by the conditions of living of the workers outside.

Introducing recess periods.—One of the common methods of reducing fatigue is by introducing recess or resting periods during a working spell. During such periods, which, in order to be effective, must be obligatory, and not discretionary on the part of the workers, they should have an opportunity to rest, relax, move about and engage in other simple recreation. A little food or a cup of tea or cocoa taken at such a time is often remarkably restorative. A very striking instance of the benefits of resting periods has recently been published. "Two officers at the front recently, for a friendly wager, competed in making equal lengths of a certain trench, each with an equal squad of men. One let his men work as they pleased, but as hard as possible. The other divided his men into three sets to work in rotation, each set digging their hardest for five minutes and then resting for ten, till their spell of labor came again. The latter team won easily." It often happens that several five-minute resting periods may be advantageously introduced into a working spell. Where this is not practicable a single recess, of suitable duration, may suffice. The recuperation thus gained by a tired worker often increases his working capacity for the remainder of the spell. If pieceworkers object to such compulsory resting periods, fearing loss of wages, it is even profitable to guarantee that during the introduction of the change the total day's wage shall not be less than before the resting periods were installed. Experience has demonstrated that after such periods have been established the resulting increased efficiency usually yields equal, if not greater, output.

Introducing variety into work.—Much of the modern industrial work consists of a constant and rapid repetition of the same movement. A woman worker in one of our munition factories was recently observed to handle during her day's work 24,000 pieces of a shell fuse and put them through a special process. From 7 o'clock in the morning until 12 and from 1 until 6 she sat at her machine and fed it with the succession of brass pieces. The occasional introduction of a little variety into her work by training her to some alternative process might easily have diminished her fatigue without diminishing the number of finished pieces.

Adjusting the speed.—The capacities of different workers vary greatly. In order to secure uniformity in the work of a squad, where a single motor operates a number of machines, the speed of the motor must be adjusted to the average pace. It may be advantageous to transfer to another job an especially fast or slow person. It is of the utmost importance that each member of the squad should be able to work with the same rythm and that the speed of operation should be adjusted to this rythm. Fatigue is least when the speed is in consonance with the worker's customary rythm, and the output may be twice as great as with a speed a little slower or even faster than this. The worker's speed, however, depends not merely on the adjustment of mechanical appliances, but is also often increased by a well-planned system of incentives, which may consist of piece rates or bonuses, or the making of the work itself more interesting and attractive.

Omitting unnecessary motions.—The pieces which the worker has to handle should be so placed with reference to height and distance from his hands that he is obliged to make no awkward, unrythmical, and unnecessary motions or excessive muscular exertions in handling them. His work can thus be done with the least possible waste of energy and time.

Providing adjustable seats.—Where workers are obliged to sit instead of stand at their work, the seats should not be of uniform heights, but should be adjusted to the individual worker, with backs of such shape and position as best to fit and support the worker's back. Such seats have recently been introduced in some of our large factories. Where the worker's feet can not reach the floor, foot rests should be provided. Such rests can be simply made by fastening a narrow board platform to the legs of the seat at the proper height from the floor.

Ventilation of workrooms.—The ventilation of workrooms is an important aid to efficiency and should conform to the principles of ventilation now accepted. The recent investigation of ventilation has demonstrated that excessive heat and humidity should be avoided so far as possible and that air should be kept in motion. When the worker is in a hot room, and especially when heat and humidity are combined, his bodily temperature rises, often several degrees, and he is put into a feverish state. While movement of the air will not cool the air, it will cool the skin and hence will keep down the bodily temperature to the healthful level. If possible, windows should be wide open; but where this is not possible and wherever even with open windows the heat of the workrooms rises above 68°, forced drafts or electric fans should be used to keep the air in motion. It is astonishing how easily a comfortable and refreshing bodily condition may be maintained by the use of electric fans. Air currents should not, however, be too strong. Bodily discomfort is caused by excessive drafts, and a gentle movement of air is the most effective. Uniformity in the play of air on the skin is undesirable; an oscillating electric fan or a frequent change in the rate of the forced drafts gives the best results.

Sanitary conditions within factories.—As accessory but none the less important means by which fatigue may be lessened and the efficiency of workers increased, there may be mentioned certain general sanitary conditions within factories:

1. Adequate lighting, with the light properly distributed and yet sufficiently concentrated on the work in hand to prevent eye strain.
2. An exhaust system to remove deleterious fumes and dust.
3. Abundant drinking water, cool but not ice cold, within easy reach of the worker.
4. Attractive, quiet rest rooms, especially for women, in which in times of need tired workers may find relief.
5. Lunch rooms or canteens, where a hot lunch of nourishing food, selected according to a scientific dietary and well cooked, may be purchased at cost prices and eaten amid attractive surroundings free from the influence of the saloon.
6. Clean, well-ventilated modern toilets.

Washing facilities, with abundant soap and clean towels, and especially shower baths, where the hot, sweaty, begrimed worker may become cool and clean before leaving the plant.

Alternating day and night work.—The industrial urgencies of the war have caused many factories to run both day and night, and have thus increased greatly the total amount of night work performed. Man is not naturally a nocturnal animal, and under our present social arrangements night work must always be regarded as inadvisable on physiological grounds. Lack of sleep produces fatigue. The day sleep of night workers is likely to be curtailed, and in the long run night work is likely to be detrimental to health. This is probably more true of women than of men. The needs of the nation may require night work as an emergency measure, but this necessity should not obscure its dangers to health. If night work must at times be done, the question arises whether it is more profitable to keep the same workers on the night shift, or to change them at intervals, say every other week, from night to day, at the same time shifting the day workers to night work. The British Health of Munition Workers Committee has made a very careful statistical study of the output under both systems and has found that where the same night shift continues to be employed the total output is less than where there is an alternation of day and night work. This is true of both men and women. Where night work is unadvoidable, therefore, fatigue can to some extent be avoided by allowing the workers to alternate at intervals between day and night, the periods to be not less than one month in duration. Frequent changes of habits may be deleterious to health.

Adjusting hours of work.—A very obvious way to reduce fatigue is by adjusting the number of daily hours of labor. The British Health of Munition Workers Committee has found that it is a mistake to recommend a uniform day for all kinds of work, that the most profitable duration of the working period varies considerably with the nature of the occupation, and that women and boys, even when engaged in moderate and light types of work, are unable to stand as long hours as men. Within obvious limits, the length of the working day that avoids excessive fatigue can be determined for the individual process only by a careful study, in each combination of circumstances, of the effect of the work on the workers. The general tendency for many years in industrialism has been to decrease the hours of labor. The one great objection that is usually raised against a proposal to decrease hours is that the output would be correspondingly diminished; and accordingly, whenever, as at the present time, unusual strain is brought upon industries and the greatest output is desired, there is a tendency to increase hours and to introduce overtime work. This objection to decreased hours and this tendency to increase them, rest in considerable part on a mistaken notion. It is obvious that a man can do more work in two hours than in one hour; but it does not necessarily follow from this that he can do more in 12 hours than in 10, or more in 10 hours than in 8. In fact, whenever the work is of such duration that fatigue begins to be pronounced, it has been shown again and again that shortening the working period actually increases the amount of work done. This may not always be evident in the first few weeks, but it appears later. Innumerable instances of this might be quoted. Thus a certain granite-cutting company found that "the same man under identically the same conditions accomplished more of exactly the same kind of work when he was working 9 hours than he did when he was working 10 hours. And again when the hours were reduced to 8 hours this same man accomplished still more in an 8-hour day than he did in a 9-hour day, or a considerable amount more than he did when the day was 10 hours long." In an English munition factory when the average weekly hours of men sizing fuse bodies were reduced from 58.2 to 51.2 the total output was increased 21 per cent. In the English factories the absences of employees from their work have increased enormously since the war began. In one of the largest munition factories, employing 70,000 hands, the efficiency of the work was thus greatly interfered with. The employers were advised to give their hands a whole holiday, instead of a half holiday, on Saturday. This was done and the absences were diminished by 50 per cent. The firm was so well satisfied with the result that it will continue the custom.

The exact relationship between length of day and quantity of output is not yet fully investigated for all conditions, but the great preponderance of evidence favors a reasonably short working day even in the interests of the industries themselves.

Avoiding overtime.—Arguments that favor the short working day apply directly to the question of overtime. If the usual day's work is such as just to stop short of undue fatigue, overtime means overwork. It is of course sometimes necessary, in order to complete a contract within a required time, to call on the workers to expend the greater effort required. It is, however, a dangerous expedient and a particularly insidious way of diminishing a worker's efficiency. Overtime work is apt to result in an increased amount of spoiled work and in lessened output and increased absences on subsequent days, and because of this and also in view of the increased rate of wages that must usually be paid overtime is not as profitable as is often supposed. It should be resorted to only in times of exceptional emergency, and even then not for many days in succession.

Omitting Sunday work.—The same principle holds for the duration of weekly labor. It is generally acknowledged by those who have studied the question most carefully that all workers should have one day's rest in seven. At the beginning of the war the amount of Sunday work in the industries of the world was greatly increased.

After little more than a year the British Health of Munition Workers Committee reported as follows:

> Statements are made by many employers that seven days' labor only produces six days' output, that reductions in Sunday work have not, in fact, involved any appreciable loss of output, and even the less observant of the managers seem to be impressed with the fact that the strain is showing an evil effect. * * * The evidence before the committee has led them strongly to hold that if the maximum output is to be secured and maintained for any length of time, a weekly period of rest must be allowed. Except for quite short periods, continuous work, in their view, is a profound mistake and does not pay—output is not increased. On economic and social grounds alike this weekly period of rest is best provided on Sunday.

Sanitary conditions outside factories.—Fatigue resulting from the work inside the plant will appear sooner and be a more serious hindrance to output if the worker is not in a sound condition of body and mind when he comes to his task. Anything which an employer can do outside the plant to promote bodily health and vigor and mental contentment is in the long run profitable. It aids in securing a higher class of workers, greater loyalty to the company, a lessened labor turnover, greater skill, and greater general efficiency. Modern housing, attractive home surroundings, opportunities for healthful recreation, club facilities—whatever will keep workers away from the saloons and other places deleterious to health—are all safeguards against industrial fatigue.

The above are some of the ways by which fatigue in industrial occupations may be reduced. Their applicability varies with the different occupations of workers. Conservation of the working power of our industrial army is as essential to our success in the war as is conservation of our military and naval efficiency and our food. Great Britain has been foremost among our allies in recognizing this, after having made during the first year of the war the costly mistake of wasting her industrial forces through needless and avoidable fatigue.

In this country the Division on Industrial Fatigue, composed of scientists organized under the Committee on Labor of the Council of National Defense and working in cooperation with the Public Health Service, is now engaged in examining munition factories and other industrial establishments that are manufacturing war supplies. It aims to bring together the combined resources of scientific investigation and the practical experience of industries in this and other countries to show how avoidable fatigue may be eliminated, and how in the present exigency the greatest output of the necessities of war may be secured compatible with the maintenance of the working power of the workers. The Divisional Committee is contributing freely the time, knowledge, and experience of its members for the benefit of the industrial work of the country and thus for the Federal service. Should any industrial corporation that is now engaged in manufacturing war supplies desire the services of the committee, communications should be addressed to the Executive Secretary at the office of the Committee, 437 West Fifty-ninth Street, New York City.

PUBLIC HEALTH NURSING COURSE IN IOWA.

An eight-week emergency course in Public Health Nursing is being conducted in Iowa under the joint direction of (1) the Public Health Nursing forces of Des Moines and the Camp Dodge Extra-Cantonment Zone, correlated under the Medical Officer of the United States Public Health Service who is in charge of the zone and is acting health officer of Des Moines, (2) a supervisor of nurses appointed by the Public Health Service, and (3) the Iowa State Tuberculosis Association. Only graduate registered nurses available for public health service in Iowa have been accepted for the course.

Lectures and conferences are given under the immediate direction of the State Tuberculosis Association by representatives of the Public Health Service, the Army, and the State and local health authorities. Half of the time required for the course is devoted to field and clinical work. One afternoon each week is given to inspection of water plants, sewage-disposal systems, dairies, hospital dispensaries, and other public institutions.

The course, which is the first of its kind to be established in Iowa, has the indorsement of the National Association for Public Health Nursing.